

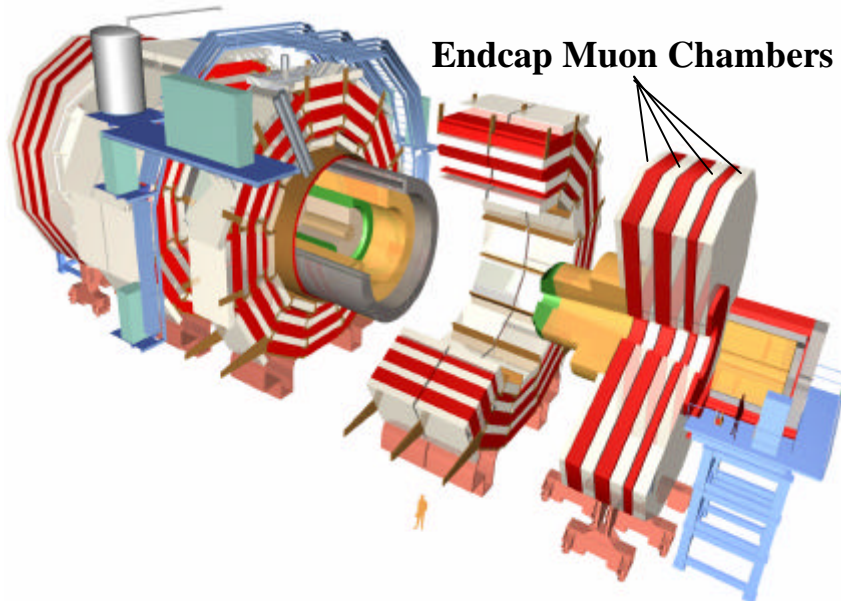
# CSC Factory Production

**Status of the CSC Factory Production  
at IHEP (China) and PNPI (Russia)**

**Oleg Prokofiev**

# Endcap Muon System

## CMS Detector



**Total Weight – 12,500 t**  
**Overall Diameter – 15.0m**  
**Overall Length – 21.6m**  
**Magnetic Field – 4.0Tesla**

**31 Nations**

**~150 Institutions**

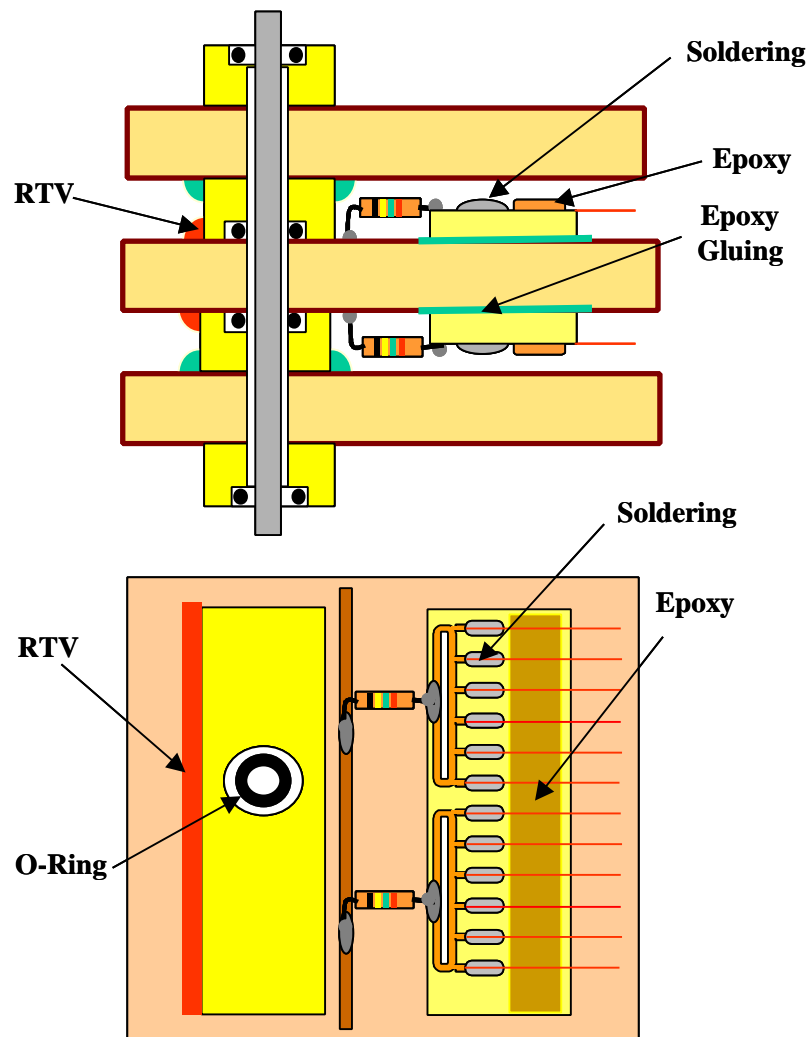
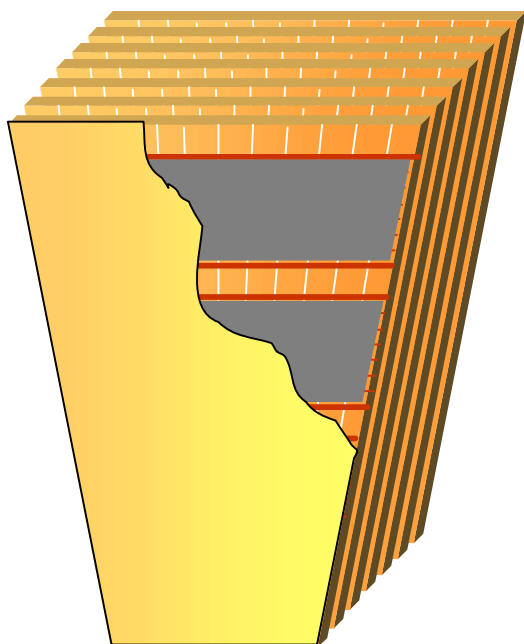
**~ 2000 Scientists**

## EMU System Parameters

- **540 Cathode Strip Chambers**  
(largest 3.4m x 1.5m)
- **6000 m<sup>2</sup> sensitive area**
- **65 m<sup>3</sup> gas volume**
- **2 500 000 anode wires**
- **150 ? m space resolution**
- **25 ns bunch crossing resolution**

# CSC Chamber Design

**Trapezoidal Six Layer Cathode Strip Chamber**



## Foreign Chamber Factory Production

**According to MOU between US CMS Collaboration and Foreign Sites:**

- **PNPI (Russia) should construct 124 ME234/1 chambers**
- **IHEP (China) should construct 150 ME1/23 chambers**
- **IHEP and PNPI will provide chamber installation, commissioning and maintenance at CERN**

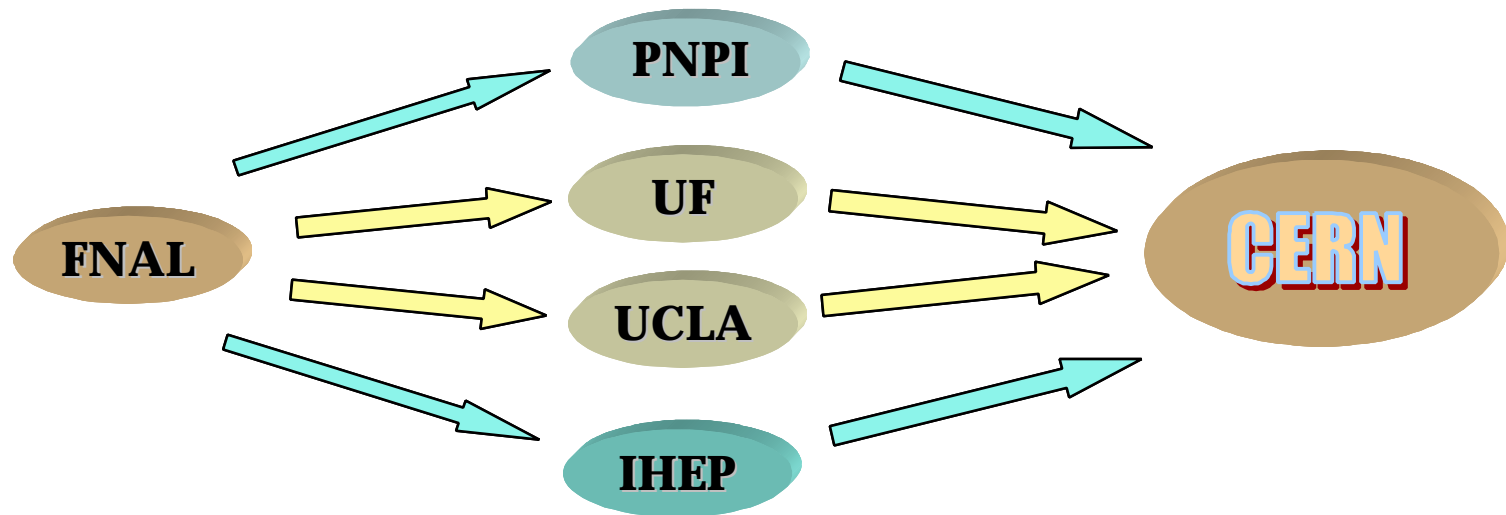
**US CMS Collaboration will provide:**

- **chamber parts and on-chamber parts**
- **critical tooling**

# EMU Chamber Production

## FNAL Responsibility:

- **ME234/2 chamber production (144 +2 spare)**
- **Panel production for all chambers (~3000 panels)**
- **Procurement ( chamber parts, frame,... )**
- **Critical tooling for PNPI and IHEP**
- **Shipment On-Chamber parts**



# IHEP and PNPI Chamber Production Status

## IHEP Status on CSC production (April 2002)

Chamber Production started on Jan. 1, 2002

Table 1: cumulative total

CSC Type	ME1/2	ME1/3
-----		
needed	74	74
-----		
Assembled and tested	18	0
Passed LT HV test	0	0
Assembled With Elect.	0	0
Passed Fast Site test	0	0
Shipped to CERN	0	0
-----		

## PNPI Status on CSC production (April 2002)

Chamber Production started on Nov. 1, 2001

CSC	ME2/1	ME3/1	ME4/1
-----			
needed	38	38	38
-----			
Assembled and Tested	24	0	0
Passed Long Term HV Test	0	0	0
Assembled with Electronics	0	0	0
Passed Long Term HV Test	0	0	0
Assembled with Electronics	0	0	0
Passed FAST Site Tests	0	0	0
Shipped to CERN	0	0	0
=====			

## PNPI Chamber Tests

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**TABLE 2. CHAMBERS FINISHED DURING THE LAST MONTH at PNPI**

=====

CSC	Date finished	Leak Rate cc/min	CSC Current at 4.0 kV uA
-----			
ME2/1-018	08.04	0.13+/-0.22	0.21
19	01.04	-0.12+/-0.59	0.24
20	03.04	0.21+/-0.24	0.14
21	10.04	0.09+/-0.28	0.13
22	15.04	0.01+/-0.20	0.14
23	18.04	0.06+/-0.19	0.13
24	24.04	0.20+/-0.20	0.16

=====

# IHEP Chamber Tests

**Table 2: chamber finished so far(Jan.1-Apr.30,2002):**

Chamber No	date dinished	Leak rate	current@4KV
ME1/2-001	2/10/2002	1.11+-0.03	0.10
ME1/2-003	2/11/2002	-0.05+-0.05	0.08
ME1/2-004	2/12/2002	0.27+-0.12	0.10
ME1/2-005	2/16/2002	0.68+-0.10	0.10
ME1/2-006	3/14/2002	0.08+-0.07	0.10
ME1/2-007	3/13/2002	0.34+-0.08	0.10
ME1/2-008	3/15/2002	0.02+-0.06	0.10
ME1/2-009	3/12/2002	0.26+-0.12	0.10
ME1/2-010	3/11/2002	0.66+-0.12	0.11
ME1/2-012	4/09/2002	0.97+-0.06	0.10
ME1/2-013	4/13/2002	0.66+-0.11	0.10
ME1/2-014	4/04/2002	0.89+-0.12	0.10
ME1/2-015	4/03/2002	0.43+-0.21	0.10
ME1/2-016	4/15/2002	0.28+-0.06	0.12
ME1/2-017	4/14/2002	1.25+-0.10	0.10
ME1/2-018	4/23/2002	0.33+-0.21	0.10
ME1/2-019	4/24/2002	1.04+-0.15	0.15
ME1/2-020	4/25/2002	0.47+-0.11	0.10

## **IHEP Chamber Production Review**

- **Chamber factory production process**
- **Electrical tests**
- **Quality control, chamber parts inspection**
- **Travelers, discrepancy reports**
- **Conclusion**

# IHEP Factory Manpower

## Factory personnel:

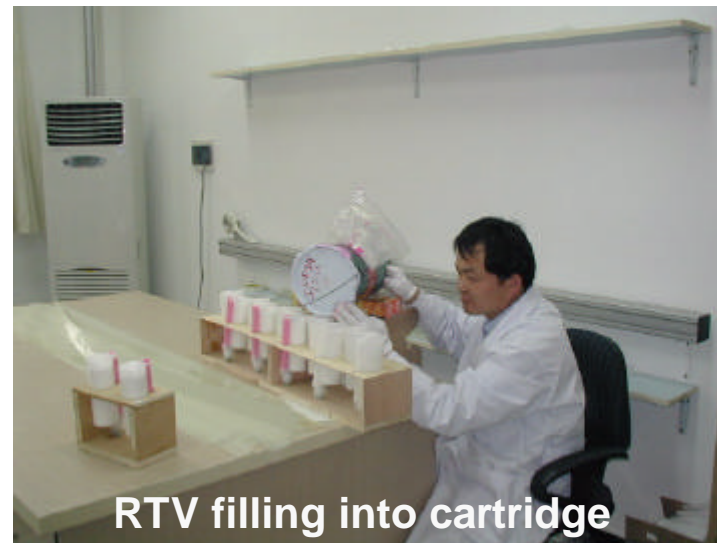
- Process engineer / flow manager (engineer) - 1
- Panel cleaning, gluing, sealing, chamber assembly (technicians) – 3
- Winding, wire soldering (technician) – 1
- Hand soldering (technician) - 2
- Tension, pitch, capacitance measurements (technician) – 1
- HV panel tests and chamber tests (technician) – 1
- Travelers, chamber assembly (technician) – 1

**Factory : 10 peoples + factory manager (physicist)**

## Material Storage



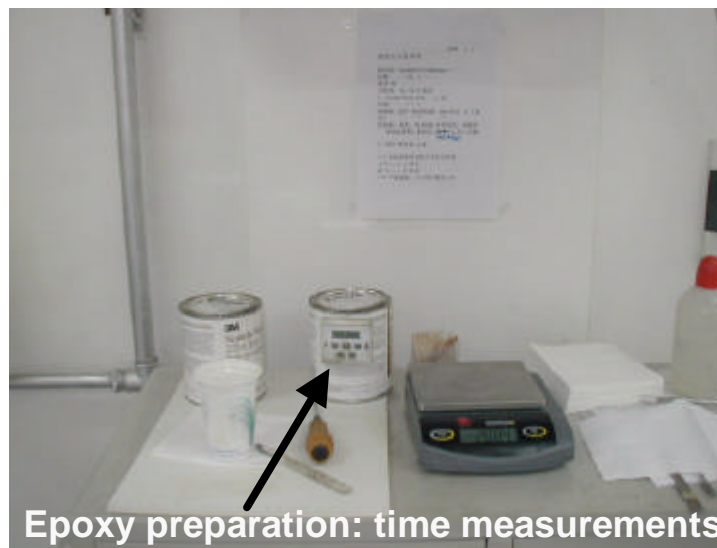
Chamber parts storage



RTV filling into cartridge

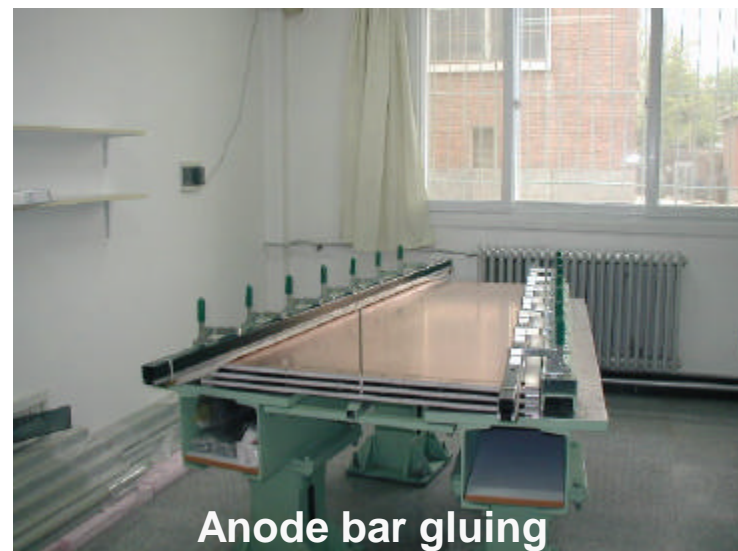
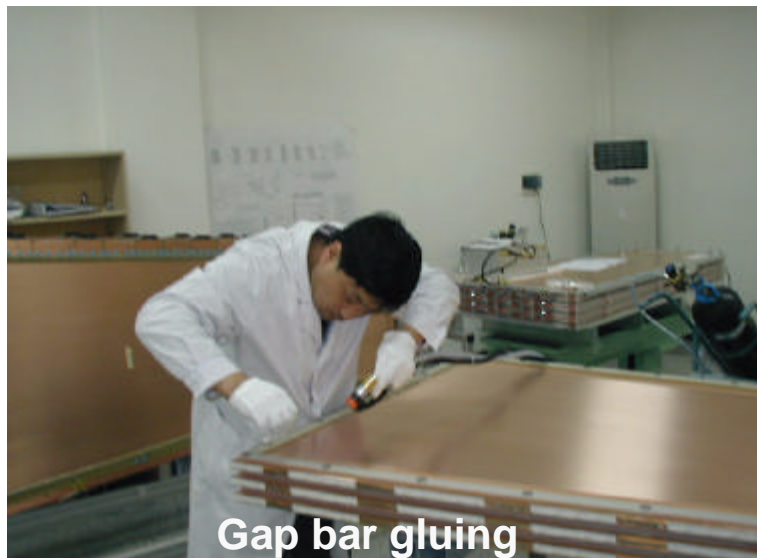


Chamber parts storage

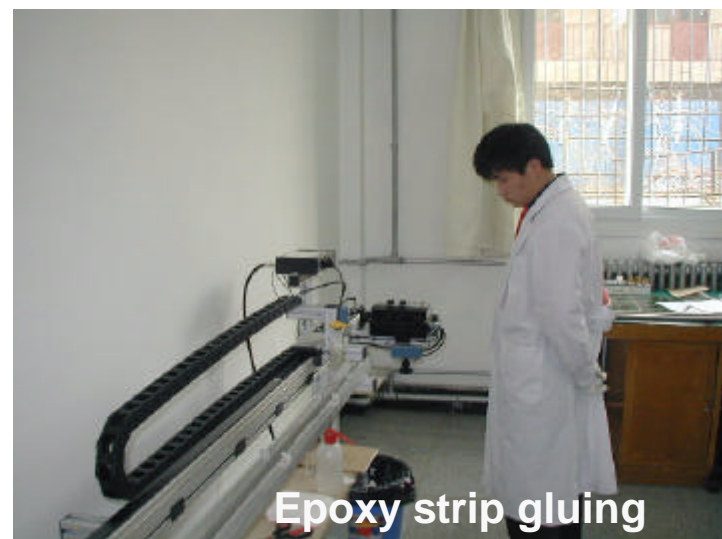
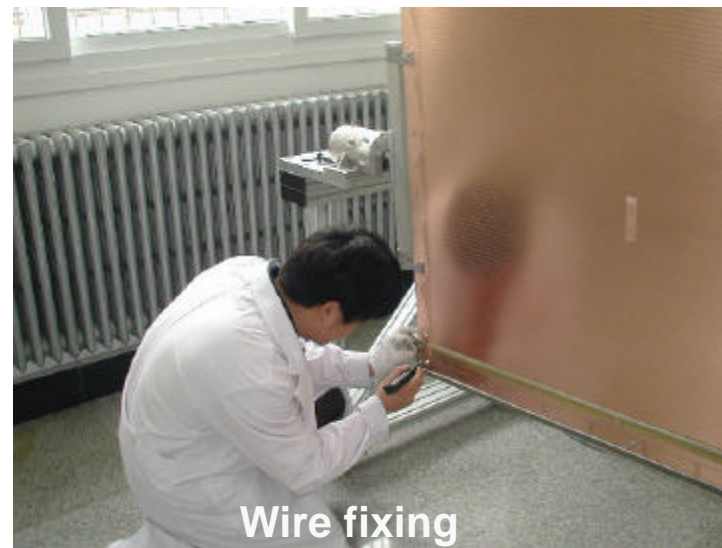


Epoxy preparation: time measurements

## Cathode and Anode Panel Gluing



## Panel Winding, Wire Gluing and Soldering



## Hand Soldering, Chamber Assembly

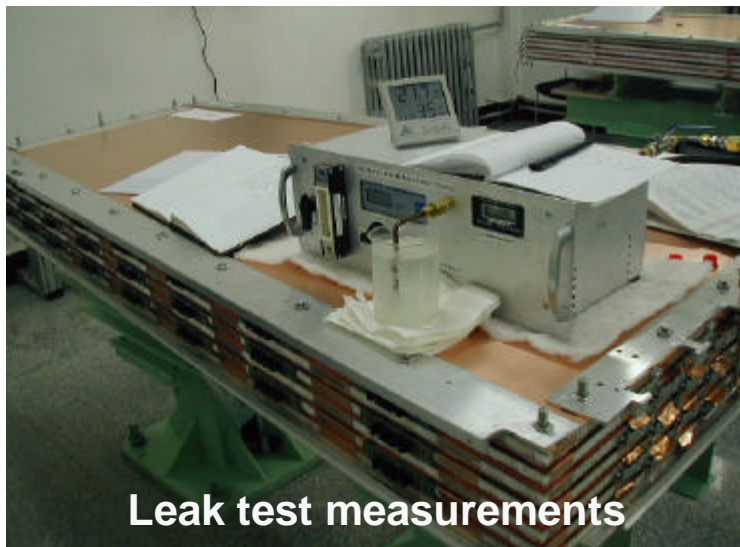


# IHEP Leak Measurements Results

The results of chamber leak rate measurements with the last five chambers

## IHEP Chamber Leak Rate data

Chamber #	Date (year/month/day)	Time (hours)	Chamber Pressure (inches of water)		$\Delta P$	Barometric Pressure (kPa)		$\Delta B$ (kPa)	Temperature (C°)		$\Delta T$ (C°)	Leak (cm <sup>3</sup> /min)	$\Delta$ Leak (cm <sup>3</sup> /min)
			Initial	Final		Initial	Final		Max	Min			
ME1/2-019	2002/4/12	23.5	2.6	2.9	-0.30	101.2	99.7	1.5	20.5	19.3	1.2	1.04	0.15
ME1/2-020	2002/4/10	23	2.68	2.87	-0.19	101.7	101	0.7	20.1	19.2	0.9	0.47	0.11
ME1/2-021	2002/4/15	23.2	2.58	1.94	0.64	100.7	100.6	0.1	20.9	19.9	1.0	0.40	0.12
ME1/2-022	2002/4/17	22	2.64	1.96	0.68	101.5	101.2	0.3	20.7	19.8	0.9	0.63	0.12
ME1/2-023	2002/4/18	22.5	2.51	2.37	0.14	101.3	100.8	0.5	20.5	19.8	0.7	0.52	0.09



## Electrical tests

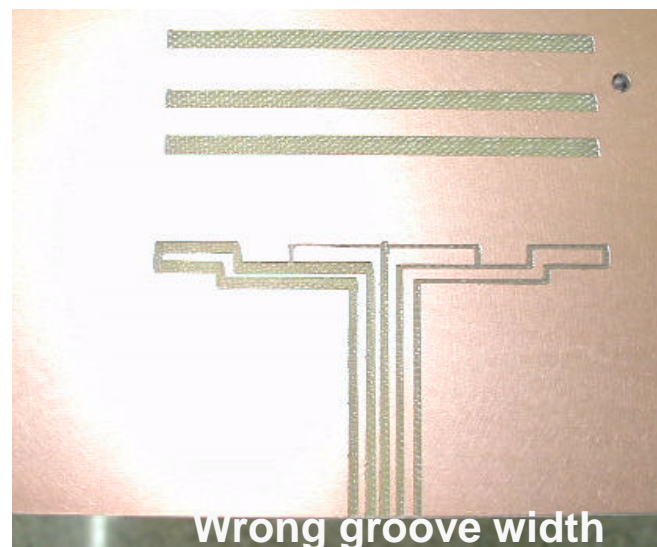
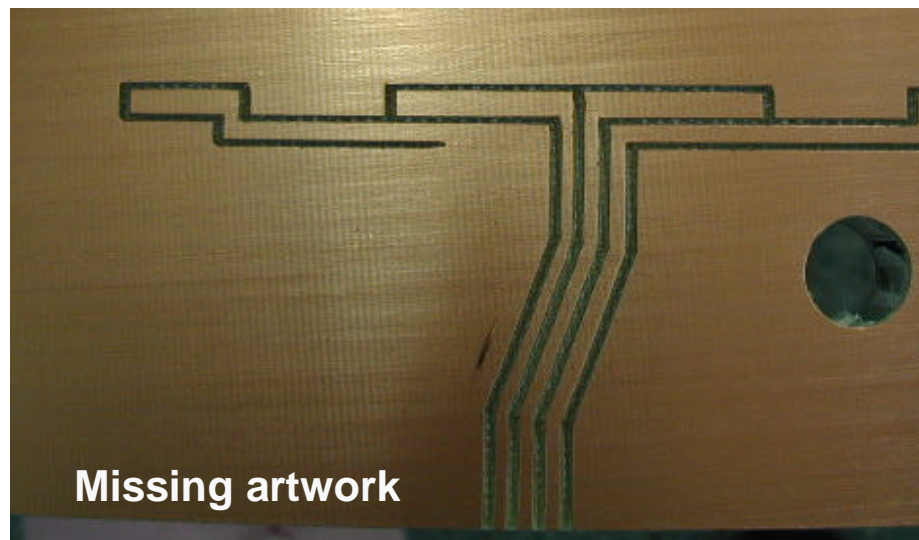
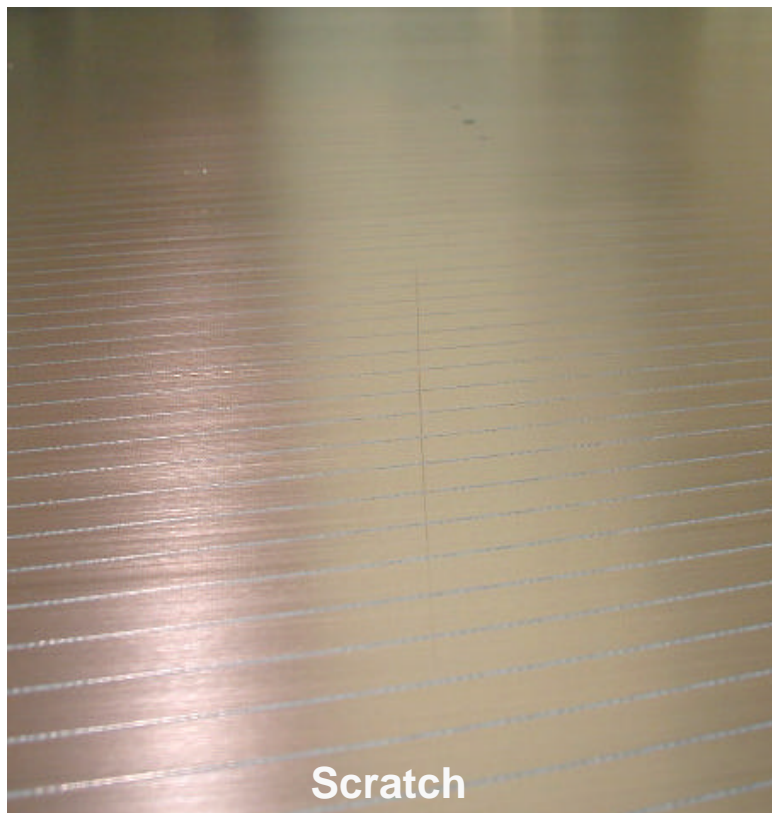


Chamber signal test



Anode panel HV test

## Panel Inspection



# Travelers and Discrepancy Reports

## Recommendation

- **Need to fill travelers at time of production procedure.**
- **Pay more attention to filling out and complicity of travelers.**
- **Only a few discrepancy reports (DR) are available.**
- **Need to fill DR when chamber parts are out of technical specs.**
- **Fill DR for any sealed chamber which have to be repaired (taking apart).**

# IHEP Factory

## **Summary of production review at IHEP**

- **The CMS EMU group at IHEP has made excellent progress toward to the chamber production.**
- **During 3 months IHEP made more than 20 chambers and has reached the full rate chamber production (6 chamber per month).**
- **The results of the chamber tests meet the of technical specifications.**
- **The factory personnel demonstrated that IHEP team has achieved a good level of knowledge and experience on all aspects of their chamber production.**

**The next step – Production Review at PNPI, Russia in May, 2002**